Space Weather Technical Forecast

Issued on Sunday, 23 January 2022 at 00:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance of G1/Minor Storm intervals from possible CME arrivals throughout. Active electron fluence continues at present.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low in the past 24 hours, with no significant X-ray flares recorded. There are now just two sunspots on the visible disc, both small and simple unipolar groups.

A filament lift off from the northeast quadrant which began around 22/0630UTC, produced a CME. Although most of the ejecta was directed away from Earth, initial modelling indicates a possible glancing pass late 25th or early 26th. No other Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, was between 480-380km/s, often steady but with an overall slight downward trend. Density has been largely near average. The Total IMF (Bt) has been weak, with the north-south component (Bz) also weak, although predominantly southward directed. The phi angle was mostly negative (towards the Sun), although with some brief switches to positive. Geomagnetic activity has been Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was just slightly elevated, but continued to slowly decline towards background levels from the recent S1 event. High energy electron flux (greater than 2MeV), is at Moderate to High levels, with a peak value of 4040 pfu at 22/1640 UTC. Electron fluence persisted above the 1e8 Active threshold, with a falling then recent rising trend. Observed fluence at 23/0000 UTC was 1.27e8 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is initially a very slight but soon diminishing chance of isolated M-class flares, as the more active region over the western limb continues to rotate further away. Very Low solar activity is then expected, with a slight chance of C-class flares.

Solar Wind / Geomagnetic Activity: There are several glancing CMEs possible in the forecast period, potentially one each day of the period. A CME from 19th Jan is possible on the 23rd. On the 24th two CMEs, one from the 20th and another from 21st Jan, could also possibly glance past Earth. Then late 25th or early 26th a CME from 22nd could glance past Earth. In the absence of the CMEs above, solar winds are expected to initially be background to slightly elevated, with an increasing chance of high speed stream influence developing from the second half of 23 Jan onwards.

The resultant forecast is very low confidence in timing and phasing of G1 risk, but higher for this being the maximum attained geomagnetic activity. In the absence of any CMEs, Quiet to

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Unsettled activity should give way to more frequent Unsettled periods, with a chance of isolated Active intervals, from later Day 1 (23rd) associated with coronal hole influences.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is forecast to soon return to Background levels, as ex-2929 rotates further away to the far side. The high energy electron flux (greater than 2MeV) is expected to continue to reach High flux levels at the diurnal peak at first. However, the forecast carries low confidence, with the potential of interruptions from CME glances. Higher confidence is the arrival of the next coronal hole high speed stream that could take effect from later Day 1 (23 Jan). The 24-hour fluence is forecast to persist above the Active threshold initially, but with an increasing chance of dropping below this level for a time into the new week.

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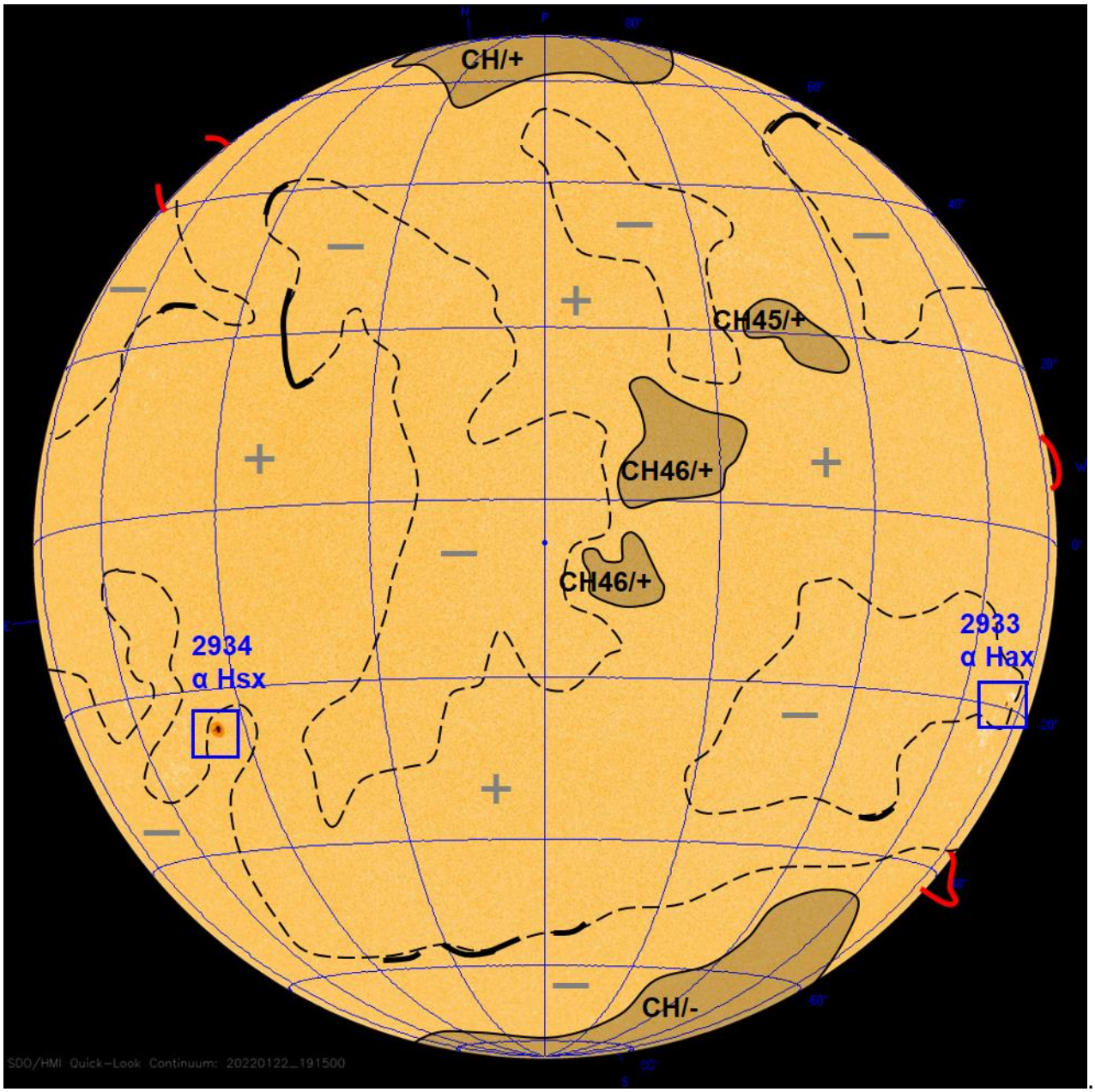
Figure 1. Solar Analysis Valid 22/1930 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are several glancing CMEs possible in the forecast period, potentially one each day of the period.

A CME from the 19th is expected to move across Earth on the 23rd. This is a slow and weak CME, but with higher confidence of arrival. The CME associated with the M5 flare on 20th is modelled as missing Earth, however a further CME, associated with an ensuing filament eruption in the southwest quadrant, is modelled as potentially brushing Earth on the 24th. A further filament eruption and subsequent CME near the SE limb on 21st Jan, could also possibly brush past Earth on 24th, but this is a very low probability as the bulk of the ejecta is directed away from Earth. Finally the latest filament lift off on 22nd has been initially modelled and shows a possible glance late 25th or early 26th. Otherwise, a high speed stream from CH45-46 is likely to reach Earth from later on 23 Jan, continuing into the 25th.
In the absence of the CMEs above, solar winds are expected to be background to slightly elevated in the short term, with an increasing chance of high speed stream influence developing from the second half of 23rd onwards.
The resultant forecast is very low confidence in timing and phasing of G1 risk, but higher for this being the maximum attained geomagnetic activity. In the absence of any CMEs, Quiet to Unsettled activity should give way to more frequent Unsettled periods, with a chance of isolated Active intervals, from later Day 1 (23rd) associated with coronal hole influences.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	20	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
19/1837	Partial	Filament	S16 W17	288	23/1500 UTC	Low confidence
20/1642	Partial	Filament	S02 W59	478	24/1200 UTC	Likely to pass ahead of Earth
21/0900	Partial	Filament	S23 E61	601	24/1200 UTC	Possible glance
22/0630	Partial	Filament	20E 15N	400	26/0000 UTC	Possible glance

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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

There are now just two front-sided sunspot regions on the disc, and neither is likely to prove capable of significant flares in their current form. Ex-2929's recent transit beyond the west limb means there is still initially a very slight but soon diminishing chance of M-class flares. There are no returning regions due in the period, however an area of brighter flux on STEREO-A imagery may indicate a possible new region, but this will take 2 to 3 days to begin rotate around the eastern horizon. Therefore, for now background level probabilities are maintained for the M-flare risk.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	2	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The assumed continued presence of Ex-2929 beyond the western limb is just maintaining the very slight risk of an S1-level enhancement at the start of the forecast period, however this risk will soon decline with continued far-side progression of this group.
The two current Earth facing sunspot groups are inactive at present, with background levels most likely for the remainder of the period.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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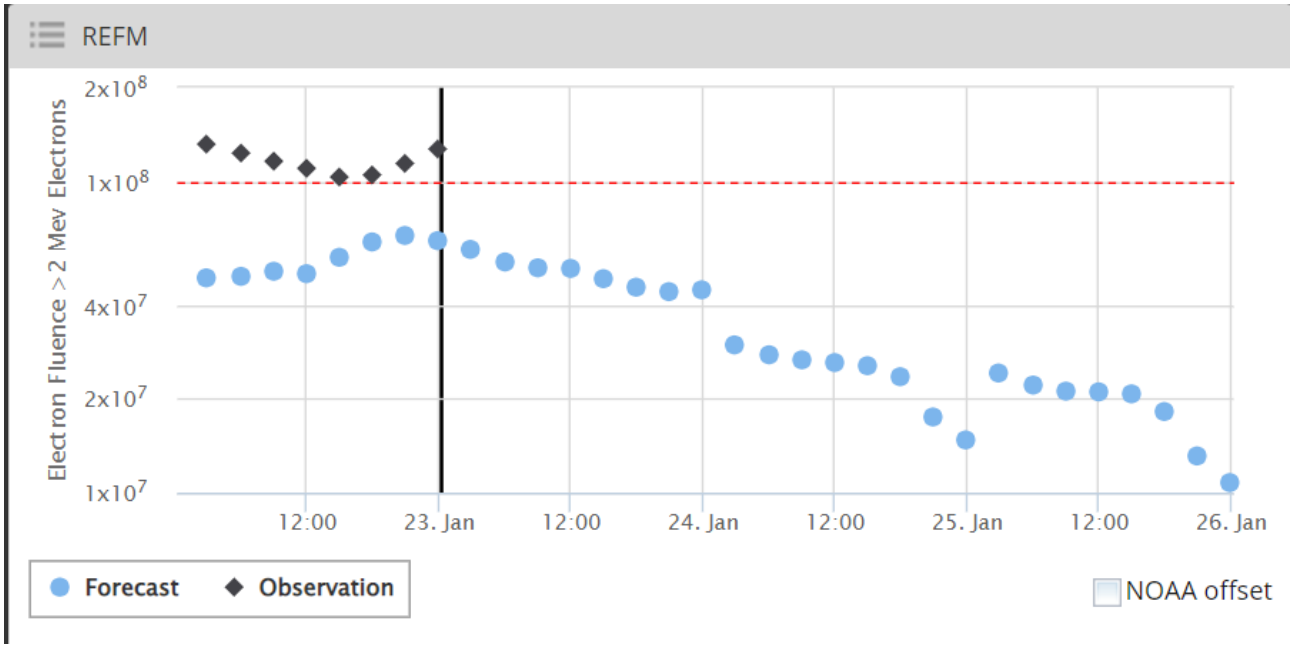
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as measured by GOES-16 at GEO, has been at Moderate to High levels after recent fast wind and CME enhancements, with a peak of 4040pfu at 22/1640UTC. Active fluence continues, with latest observations just above the Alert threshold. Detail in the forecast is very low confidence given the potential passage of several CMEs, the timing and phasing of which are uncertain. Of greater confidence is the arrival of the next coronal hole high speed stream that could take effect from later Day 1 (23 Jan), with HSS influence then likely continuing for much of the rest of the period, before waning later. Electron populations may become enhanced again in the second half of the period, but competing against this could be spells of enhanced geomagnetic activity from any glancing CME influences.

Again because of the heavily transient-influenced forecast, the signal from REFM should be considered low confidence, however the general downward trend is accepted.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	70	40	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: MOSWOC REFM



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